

University of Mississippi eGrove

Publications of Accounting Associations, Societies,
and Institutes

Accounting Archive

1923

Cost problems in the wrought iron industry

Carl G. Jensen

Follow this and additional works at: https://egrove.olemiss.edu/acct_inst

Recommended Citation

Jensen, Carl G., "Cost problems in the wrought iron industry" (1923). *Publications of Accounting Associations, Societies, and Institutes*. 81.
https://egrove.olemiss.edu/acct_inst/81

This Article is brought to you for free and open access by the Accounting Archive at eGrove. It has been accepted for inclusion in Publications of Accounting Associations, Societies, and Institutes by an authorized administrator of eGrove. For more information, please contact egrove@olemiss.edu.

**NATIONAL ASSOCIATION
of
COST ACCOUNTANTS**

**Affiliated with The Canadian Society
of Cost Accountants**



Official Publications

Vol. IV

JAN. 2, 1923

No. 8

**Cost Problems in the
Wrought Iron
Industry**

**BUSH TERMINAL BUILDING
130 WEST 42nd STREET, NEW YORK**

**NATIONAL ASSOCIATION
of
COST ACCOUNTANTS**

**Affiliated with The Canadian Society
of Cost Accountants**



Official Publications

Vol. IV

JAN. 2, 1923

No. 8

**Cost Problems in the
Wrought Iron
Industry**

**BUSH TERMINAL BUILDING
130 WEST 42nd STREET, NEW YORK**

NATIONAL ASSOCIATION OF COST ACCOUNTANTS

Affiliated with The Canadian Society of Cost Accountants

Official Publications

Vol. IV, No. 8

January 2, 1923

Cost Problems in the Wrought Iron Industry

CARL G. JENSEN, COMPTROLLER
A. M. Byers Company,
Pittsburgh, Pa.

BUSH TERMINAL BUILDING
130 WEST 42nd STREET, NEW YORK CITY

The National Association of Cost Accountants does not stand sponsor for views expressed by the writers of articles issued as Publications. The object of the Official Publications of the Association is to place before the members ideas which it is hoped may prove interesting and suggestive. The articles will cover a wide range of subjects and present many different viewpoints. It is not intended that they shall reflect the particular ideas of any individual or group. Constructive comments on any of the Publications will be welcome.

Additional copies of this Publication may be obtained from the office of the Secretary. The price to members is twenty-five cents per copy and to non-members seventy-five cents per copy.

COPYRIGHTED BY
NATIONAL ASSOCIATION OF
COST ACCOUNTANTS

JANUARY 2, 1923

National Association of Cost Accountants

COST PROBLEMS IN THE WROUGHT IRON INDUSTRY

(As applied to the manufacture of Muck Bar, Skelp and Pipe)

NOTE: This paper is one of a series presented before the Pittsburgh Chapter. These papers dealt with the cost accounting in the iron and steel industry from the ore to the finished product. It is the intention of the Publications Department to publish some more of these papers as Official Publications.

The subject assigned to me is rather long to be treated fully in one paper and it was originally intended that parts should be presented at each of two meetings of the Pittsburgh Chapter. The subject really covers the output of three or four kinds of plants grouped under one heading, the product of each of which is a finished product by itself and presents its own cost problems to be solved.

Our product is measured in gross tons, net tons, feet, pounds and pieces.

Burden costs are distributed on the basis of tons, furnace hours, machine hours, man hours, total labor, surface covered and on weighted averages recalculated periodically.

Process costs, operation costs, job costs and departmental costs are used.

I will refer to blast furnace costs very briefly for the purpose of bringing out that, while the method of finding pig iron costs is the same for all grades of pig iron, the costs of the different grades vary somewhat because of the costs of particular grades of ore and because the coke consumption and the production of iron per day is not the same for all grades of iron. The principal grades of pig iron are basic, gray forge, foundry and bessemer. There are subdivisions for each grade because of variations in the percentage of carbon, silicon, phosphorus, etc. Wrought iron and steel are, of course, both made from pig iron but the difference between the two begins with the iron used. In the manufacture of wrought iron the pig iron used has a different analysis from the iron used in the manufacture of steel. In steel manufacture varying percentages of outside scrap can be mixed with the pig iron used. Some manufacturers of wrought iron also use a mixture of pig iron and steel scrap in puddling. The manufacturers of genuine wrought iron use only gray forge pig iron with no mixture of scrap of any kind. Of course, crop ends, shearing, etc., are reworked.

WHAT IS GENUINE WROUGHT IRON?

Genuine wrought iron is a highly refined iron, very low in carbon content, thoroughly mixed with a slag composed principally

of silica of iron. This slag when in proper form is a glass-like substance evenly distributed through the product in such a manner that there are no lumps or pockets but so that all the fibres of the iron are covered and protected. This slag resists corrosion and, therefore, the rust resisting qualities of genuine wrought iron are due principally to the proper distribution of this element.

Wrought iron is fibrous and tough. Steel is crystalline and hard and has greater tensile strength than iron.

USES OF WROUGHT IRON

Because of its lower cost and possibility of quantity production steel has largely displaced wrought iron except where the desirable properties of wrought iron create a demand for it. Some of these uses are pipe, blacksmithing iron, bolts, bars, tie plates, chains, nails, etc.

PUDDLING

The process of manufacture peculiar to wrought iron is the puddling process. Through this operation pig iron becomes wrought iron. Puddling is a hand operation in that the iron is charged and worked by hand. A puddle furnace is a small low furnace with a door about 3 feet above the ground through which the pig iron is charged cold. The furnace is built of brick and lined with fire clay and ore. Coal is the usual fuel. Each pig iron charge weighs from 550 to 600 pounds. When the charge has been melted it is worked continuously by the puddler for about two hours. In working the molten metal the puddler uses a long iron bar inserted through a hole in the iron door of the furnace. During the process of working, the impurities in the iron run off in the form of a cinder. When the puddler judges the iron to be sufficiently refined, he allows it to cool into a spongy mass called a ball which is carried to a sort of blooming mill called a squeezer where the ball is made into a bloom and then rolled into muck bar. One squeezer and one set of rolls can take care of the output of about forty furnaces.

The cost elements to be considered are: Materials, Labor, Fuel, Furnace Losses, Repairs and Overhead.

MATERIALS

All pig iron, ore, scale, pipe scrap and swarf charged are weighed for each furnace. When the wheelers go into the mill, their loads are weighed as they pass over the scale placed at a convenient point. The value of the materials charged is based on actual delivered cost per gross ton as determined from the plant ledgers.

LABOR

Puddlers usually work in pairs and they are paid a certain amount per ton of finished muck bar produced. It is necessary,

therefore, to weigh the finished product not only to find the exact weight of product but as a basis for paying the tonnage labor. The rollers are also paid on a tonnage basis. The laborers who wheel in the charges, clean up the mill, etc., are paid by the hour. The per ton cost of this class of labor should vary very little during periods of normal operation.

FUEL

The puddling of one ton of iron consumes nearly two tons of coal. It is important that an accurate record of consumption be kept and comparisons made with other periods.

FURNACE LOSSES

In the puddling process some iron will always run out of the furnace with the cinder and some will be consumed. The percentage of this loss depends to a large extent on the skill and care of the puddler. An accurate record of weight of material charged and produced is necessary if a correct percentage of loss is to be known.

REPAIRS

The principal repair item is the rebuilding of furnaces. This involves auxiliary department labor and repair materials, principally brick. All repair labor is charged on the basis of hours worked and repair materials are charged at cost.

OVERHEAD

This covers such items as foremen's and weighmen's time, hauling ashes and other miscellaneous items, power from the central power plant, light, water, supplies and a proportion of general plant expense.

COST UNITS

The cost is a process cost determined for any desired period. Monthly costs are perhaps the most convenient base. The unit of production is the gross ton (2,240 lbs.) and all component costs are calculated on this basis.

The production of muck bar is comparable with the steel process of producing the ingot and the bloom.

FINAL COST

As soon as possible after the end of each month the reports of material charged, production, repairs, labor, etc., are sent from the plant division of the cost department to the general cost department where the various burden costs are computed, unit values applied and the final costs found. In this department control ledger accounts showing quantity, unit value and total amount are carried for each class of material. Plant records are carried in units only.

SKELP

Muck bar is wrought iron and there are numerous small puddle mills which manufacture and sell this iron as their finished product. In the manufacture of pipe the next process is the manufacture of skelp or plate iron which in itself is also a finished product.

A skelp mill usually consists of from one to three furnaces with the power and rolling equipment necessary to produce the desired product. A skelp mill produces a certain range of sizes as from 1" to 7", 8" to 15", etc. Plate mills as used in this connection produce the same product as the smaller skelp mills except for the fact that the sizes are larger and side shearing is necessary.

These furnaces are much larger than puddle furnaces and the fuel used may be coal, natural gas, producer gas, powdered coal, or any other suitable fuel.

OPERATING PROCEDURE

Having decided the kind of skelp to be rolled, it becomes necessary to prepare the pile of iron for heating. The exact length, width, height and weight of a pile necessary to make a certain size of skelp is known. The iron must also be piled according to a prescribed method. These piles are put in the furnaces, heated for the required length of time and then rolled into the required width and thickness of skelp.

The thickness of the wall and the inside diameter of pipe is covered by standard specifications and the skelp necessary must conform to these sizes.

The cost problem consists largely in securing the following information:

1. Accurate weights of materials charged by size of skelp produced.
2. Accurate weights of good production by sizes. Also recoveries of crop ends, defective materials, etc., as they effect these skelp sizes.
3. Correct labor distribution by sizes.
4. Furnace hours of operation by sizes.
5. Fuel.

It is my understanding that in most skelp mills the unit cost is based on a compilation of the total cost for the period divided by the total tonnage of good production of the mill. This is defended occasionally on the ground that most of the labor is on a tonnage basis and, therefore, the variation between sizes will be slight.

I contend that where there is a considerable range of sizes rolled in a mill this average method is not sufficiently accurate. As an example take one case with which I am familiar. In connection with the smallest size skelp made in this mill, the output on a 12 hour turn was usually about 12 tons while the production of the largest size of skelp for the same period was 70 tons. Granting

that the per ton cost for labor paid on a tonnage basis was the same in each case (and at times it was not) the fact remains that the cost of hourly labor, fuel, furnace repairs and depreciation would be approximately the same for the 12 tons as for the 70 tons.

In like manner it happens that, on certain sizes, mills can make higher percentages of good product than on others. The sizes where performance is comparatively poor, naturally, should cost more per unit of good product.

ACCURATE WEIGHTS BY SIZES

The element of furnace loss through iron burned and iron run off with the cinder is important because in this particular operation the loss is large. The item of scrap loss through defective pieces, crop ends, etc., is very important as a check on the efficiency of the operators.

Therefore, on each size we must have: 1. Exact weight of charge, 2. Exact weight of good product, and 3. Exact weight of scrap.

This enables us to get the furnace loss by elimination.

FURNACE HOURS BY SIZES

The best base we have found for measuring operation is the furnace hour because day labor, fuel consumption, repairs and depreciation will be about the same for each hour of operation regardless of the size or quantity of skelp produced.

COMPILING THE COST

The first step in compiling the cost is to find the material cost by taking the value of material charged less the assigned value of scrap recovered. This sum divided by the units of good production gives the unit value of material.

The second step is to apply the tonnage labor on the basis of tons of good product.

The third step is to take the total of all fuel, repairs, day labor, depreciation and overhead, less the value of cinder and scale recoveries. By dividing this total by the total number of furnace hours, you get the total cost per furnace hour. A record has been kept of the number of furnace hours applicable to each size. The number of hours multiplied by the cost per hour gives the cost per size. This figure divided by the units of good production gives the figure which added to material and tonnage labor cost makes up the final unit cost of good material.

RECORDS

A control ledger shows tonnage, unit cost and total value of each size of skelp made. This value is used in charging the skelp to the pipe mills. Either average cost or the oldest cost can be used.

PIPE WELDING

In welding pipe the skelp, which usually averages about 20 feet long, is charged at the back of the furnace, heated to a suitable temperature and then drawn out at the front of the furnace and welded.

Butt weld pipe is welded as drawn from the furnace by being drawn through a flanged bell, the flanged end of which is wide enough to admit the flat skelp, and the hole in the other end being the exact outside diameter of the pipe. As the two edges of the skelp butt together in the bell, they are firmly welded. The largest size of iron pipe usually made by this method is 1½".

In making lapweld pipe the skelp passes through two furnaces built in pairs, these being the bending and welding furnaces. Skelp is charged in the bending furnace, heated and when drawn out is bent so that the two edges come close together but do not touch. This bent skelp is immediately passed to the welding furnace where it is heated to a higher degree of temperature, and is welded when being drawn from this furnace. The method of welding is as follows: The edges of the skelp have been beveled so that they can overlap. The pipe is passed over a projectile shaped ball which is of the exact inside diameter of the pipe. The pipe is welded under pressure between this ball and a roll. It is then passed through different sets of rolls to be rounded and straightened.

These welding furnaces are heated by natural gas, producer gas, powdered coal or oil.

The total cost of operation of each furnace, if butt weld, and of each pair of furnaces, if lapweld, can properly be based on the furnace hour. The labor is on an hourly basis. The crew is practically the same regardless of the size of pipe welded, and fuel, repairs and overhead vary very little, if at all.

All furnaces are more efficient in welding pipe of some sizes than others. The cost of its operation by sizes, therefore, is, dependent upon: 1. Number of good pieces produced per furnace hour, and 2. percentage of good product.

It is necessary to weigh: a. Skelp charged on each size, b. good pipe produced on each size, and c. defective pieces and crop ends on each size.

The number of pieces, both good and defective, is also recorded as the operating records are based on pieces and, if a bonus system is in use, it is probably based on the number of good pieces produced in a given time above a fixed minimum.

In calculating the cost of furnace operation the month is used as a basis of time. The total operating cost of the department divided by the number of furnace hours for the month gives the cost per furnace hour. This cost per furnace hour multiplied by the number of hours for each size of pipe gives the operation cost for that size. This cost divided by the unit (tons or feet) shows the operation cost per unit. This operation cost added to the material cost indicates the final welded cost.

In determining the material cost it is necessary to classify the defective pipe and scrap recoveries so that different values can be used in crediting the recoveries. These values depend on the cost of re-working the recovered material.

FINISHED PIPE

After welded pipe is inspected, it is passed on to the finishing departments where the following operations are performed: 1. Pipe is threaded or, if plain end, the ends are smoothed; 2. each piece is hydraulically tested at the prescribed pressure; 3. couplings are screwed on; 4. small pipe is bundled and large pipe provided with thread protectors; and 5. all pipe is finally inspected before going to the stock pile.

In the operations involved in the finishing of pipe the principal elements of cost are labor, supplies and general expense, the latter being rather heavy because of the room occupied and the heavy investment in equipment.

It is necessary to have a rather minute labor distribution and to record both man hours and machine hours. The threading and testing costs are logically based on machine hours by size and finish, but they have to be modified because with the same machines, more men are needed for some sizes than for others. When couplings are put on by machine, the machine hour rate prevails; when put on by hand, man hour rates are used. Some small sizes are straightened by hand which means distribution by man hours. Larger sizes are straightened by machine, which necessitates a machine hour distribution.

Bundling and inspecting are based on man hours by sizes.

Bundling rope must be charged to the sizes using rope; thread protectors and couplings must be charged by sizes; and oil is charged on the basis of threading machine hours.

Where dozens of sizes and finishes are completed in each finishing department there is much labor for handling, cleaning, scrap handling, etc., which cannot be distributed to size or kind. Each class of labor has to be allotted on the best available basis, i. e., tonnage, number of pieces, etc., and must bear its own proportion of the departmental overhead cost.

Sometimes threaders, straighteners, etc., work on a sliding scale of hourly pay and bonus. This bonus must be charged to the sizes on which earned.

Depreciation, machine repairs, etc., must be charged to the sizes and kinds of pipe on the basis of equipment and space used.

One of the most difficult problems encountered in the finishing department is the correct distribution of labor and burden to the work in process at the end of the cost period. The problem is complicated because various sizes of pipe and different lots of the same size are in varying stages of completion.

The production order system is not practical because different lots of the same size of pipe cannot be kept separate through the

process of manufacture without a great deal of extra expense, inconvenience to the operating department, loss of time and the use of extra floor space.

The final cost of a size or kind of pipe is determined by adding the finishing floor and coupling cost of the different sizes of pipe to the cost of the pipe as it came from the welding department.

The small quantity of defective pipe found in the finishing department is credited at determined values. The unit cost is expressed in feet and tons.

A ledger control account is carried for each size and kind of pipe. This shows the number of feet, unit value and total value and is used as a basis for finding the cost of sales. Average value or the oldest value can be used.

GALVANIZING

A certain percentage of the small and medium-sized pipe is galvanized. The cost finding for this operation covers problems different from any of the other processes. After the pipe has been tested and inspected (but not threaded) in the finishing departments, it is sent to the galvanizing shop. There it is first weighed, then pickled in an acid bath to remove all dirt, weighed again, passed through the galvanizing kettle which is filled with molten spelter, cooled, weighed and passed back to the finishing department to be threaded, tested and inspected again. In this process the labor problem is largely a matter of handling by crane, truck or hand. The number of man hours per size of pipe is easily ascertained and, therefore, labor and departmental burden are distributed on the basis of man hours. If a bonus is paid, it is, of course, distributed directly to the sizes on which earned. The greater part of the cost of the galvanizing operation is the spelter used. Acid, fuel and other supplies are comparatively inexpensive. All materials, therefore, can be distributed on the basis which is correct for the distribution of the spelter cost. One method is to distribute on the basis of surface covered. This can be determined by calculations based on the inside and outside diameter of the pipe.

Another method is based on the increase in weight of each size of pipe between the weight after pickling and the weight when leaving the galvanizing shop. I believe the latter method is more accurate because the first method presupposes that the coat of spelter is of exactly the same thickness on all sizes and at all times.

COUPLINGS

Couplings are first welded by sizes, from specially rolled skelp, in a socket welding department. The cost of this department is accumulated in a separate account and then distributed to sizes on the basis of furnace hours. The cost per coupling is found by dividing the number of good couplings into the sum found by taking the cost per furnace hour times the number of hours operated on that size, less the value of scrap recovered.

The total of each size is charged to a control ledger account showing the number of pieces, unit cost and total value.

The cost of finished couplings is found as follows: Take the total departmental cost for the month and divide it by the total number of machine or spindle hours to get the cost per hour. The number of hours for each kind of couplings has been recorded and, therefore, the operation cost per kind and per unit is easily found.

This cost when added to the value of welded coupling charges less scrap gives the final cost.

A ledger account showing the number of pieces, unit value and total value is carried for each size. This is used as a basis for charging the finishing departments with couplings used for each size or kind of pipe. Either the average or oldest price can be used.

MAINTENANCE AND SERVICE DEPARTMENTS

Maintenance and service departments consist of machine shops, tap and die shops, carpenter shops, steamfitters, millwrights, riggers, pattern shops, electrical repair crews, teams and trucks, general labor gangs, bricklayers, etc., in fact, all departments which work for or in the direct operating departments only at such times and for as long a period as needed.

The total cost of each of these departments for the month (or other cost period) can be accumulated in a separate account. Daily service cards for each man, machine, team or truck make it possible to find the exact number of hours worked for each of the other departments during the period. The total cost of the department can then be distributed to other departments on the basis found to be most equitable. This basis may be machine hours, service hours, man hours or total amount paid the men working in each of the various departments. If sufficient basic information to permit of distribution as outlined above is not available some method of apportioning the costs will have to be substituted.

POWER AND WATER

The total cost for each class of power and for water expense for the month is found. This total is then distributed to the department using power and water on a consumption basis. This basis may be the consumption actually measured, or the estimated consumption, or the maximum possible consumption or a combination of a service and consumption charge.

The distributions of the products of power producing units and water plants interlock in such a way that the final cost can not be found without some calculating; for example, if 30% of steam power is used by the electric power plant, 20% of electric power by the water plant and 20% of the water pumped is used in the steam power plant, the total amount to be distributed in closing out the total cost of each department depends on the total of each of the other departments. The total to be distributed for any one of the three departments cannot be accurately determined until the charge from the other departments is known.

REPAIRS AND NEW CONSTRUCTION

No repair work and no work on new construction should be done except on job or shop orders. These can be issued by a clerk at the request of the master mechanic, construction foreman or other authorized person, and be signed by the superintendent or someone designated by him.

All material charges issued from the storeroom must show the job or shop order number and all service cards of the repair or maintenance departments must show clearly the time spent on each job. By this means the cost of each repair or construction project can be accurately computed by the cost department and charged to the proper account.

PLANT RECORDS

All stores, supplies, repair parts, etc., should be carried in a storeroom and issued only on requisitions properly signed. These requisitions can be priced from store cards and summarized for total charges to departments.

Store cards showing quantities, unit and total values, and maximum and minimum quantities can be used to great advantage in keeping inventories low without hampering operations and for having instantly available, information concerning prices, previous purchases, consumption, etc.

Daily stock sheets of finished products should be available for use by the planning and sales departments as well as the executives.

Stocks of raw or partly finished materials should be known at all times through stock records kept up to date. Daily or weekly inventories should be taken of consumable materials which move rapidly. Daily production and labor reports must be available for use by the operating officials in order that they may be able to keep in close touch with conditions.

CENTRAL COST DEPARTMENT

By a certain date after the end of the cost period (which is usually a month), all reports from the various plants must be in the hands of the central cost department. These reports cover the entire range of plant activities, which affect costs, the principal ones being labor distribution, departmental transfers and reports of materials and supplies consumed, lost, destroyed, etc.

The invoices for the previous month must be analyzed by the same date.

It is necessary that the date set for having all reports in the hands of the cost department be definitely fixed and be as early in the month as possible. Excuses for delays on the part of any reporting department should be accepted only in extreme cases.

With all information at hand the cost department can assemble the final costs. With an account for each department all charges and credits are posted to the proper accounts. A trial balance can be taken to prove the accuracy of this work and then all operating accounts can be closed in the prescribed order. The most satisfactory order is probably as follows:

First, distribute the cost of all repair, maintenance and service departments, beginning with the least important, and then make the accumulations of the power departments and the mill overhead. When all accounts have been closed except the accounts for the operating departments, the latter are closed in the order in which material is used. In this case the order is:

1. Blast furnace.
2. Puddle mills.
3. Skelp mills.
4. Welding mills.
5. Galvanizing department.
6. Coupling departments.
7. Finishing departments.

As each department is closed the proper inventory account is charged so that the correct cost of material to be charged to the next operation can be determined.

A ledger account is carried with each kind and size of pipe. There are also sub and general control accounts. The month's production is posted before the cost of sales can be finally determined. Each account shows the number of feet in stock, the unit value and the total value. Either average value or oldest value can be used in calculating the cost of sales.

As there are several hundred kinds and sizes of pipe made by any large pipe mill it will readily be seen that a great deal of computing is necessary. In fact, without the use of mechanical equipment it would be almost impossible to do the necessary work.

MECHANICAL EQUIPMENT

The following equipment has been found to be practical and valuable:

1. Listing-adding machines located in the pipe finishing department to record production.
2. Non-listing calculating machines for addition, multiplication and division for use in compiling and checking. These are particularly good where the operators are skilled and the records are so designed that the operators work to control figures.
3. Listing adding machine fitted with hektograph ribbons used in filling in necessary figures on forms printed with hektograph ink. They are for use where more than one copy is required.
4. Tabulating machines for use in making labor distributions. These can, if so desired, be used for compiling pay rolls, stores and stock records, production records, etc.
5. Commercial duplicators can be used very advantageously in making records where more than one copy is required.

STAFFS

To secure the proper basic information with reasonable accuracy it is usually necessary that such information should be

recorded in the mills by clerks under the supervision of the accounting department.

If the central cost department is not located at the plant all tabulations, summaries, etc., should be made by cost department clerks located at the plant where immediate consultation with mill clerks can be had in case of errors, omissions or changes.

The number of clerks will depend on the skill, hours, duties and the number and size of departments to be covered.

INVENTORIES

Perpetual inventories of stores, supplies, repair parts, raw materials and finished products should be carried. Instead of taking one inventory as a check at the end of each fiscal period the stock should be checked continually, a certain part each month or week. All items should be carefully checked (and adjusted if necessary) when the stock is exhausted or very low. Net overruns or shortages can be absorbed at the end of a cost period or at the end of a fiscal period.

RESERVES

Inasmuch as repairs cannot be equally distributed over cost periods it is sometimes advisable to establish reserves through charges to current costs to equalize the cost of large and frequent but irregular repairs.

In the kind of business under review the principal repair of this nature is repairing and rebuilding skelp and pipe mill furnaces. It is advisable to equalize this expense by establishing a reserve through regular charges to current costs, the amount of the reserve provision being based on the actual cost of repairs and rebuilding over a period of years.

FIXED PROPERTY ACCOUNTS

The value of having proper records of land, buildings, equipment, etc., is firmly established. These records can be kept in the cost department or in a separate department but in either case they are of value in determining costs.

DEPRECIATION

The writer is a firm believer in charging depreciation into costs by departments or operations. That depreciation is an element of manufacturing cost is, I believe, conceded by all or nearly all cost accountants. If this is true the proper place to charge it is into the costs and the time to make the charge is when the costs are computed. The rates should preferably be established by a competent authority such as an appraisal company or engineer with a good reputation, but may be established by the company's own engineers or executives. In either case it is possible to secure different rates for the different classes of buildings and equipment

and to secure average rates by classes, groups or departments. By the use of these average rates the provision for each class, group, department or operation for any cost period can be determined. Once determined it is a simple matter to charge the item into costs for the period. It is also possible to secure both "net" and "gross" rates of depreciation for each group, class or department. By "net" rate is meant the estimated loss suffered through deterioration over and above all repairs and maintenance charges. By "gross" rate is meant a rate which includes the net rate plus a percentage to cover the cost of all replacements, maintenance and repairs. If desired a certain minimum can be set, that is, all repairs below \$5.00, \$25.00, \$50.00 or whatever limit is set will be charged to current operating cost and all repairs costing more than the minimum set will be charged to the depreciation reserve.

In a "gross" rate that part of the rate in excess of the "net" rate will depend to some extent on the current price level and will also depend largely on the repairs actually found to be necessary over as long a period as can be analyzed. The principal advantage of using a "gross" rate of this kind is that in a period of forced or heavy operation when as much maintenance as possible is deferred to later periods, it is possible to charge the cost of the product during these busy periods with the cost of repairs and maintenance actually incurred but not expended. At the same time repair work can be done in slack periods without unduly burdening the production costs of such slack periods with the cost of repairs and maintenance, the necessity for which did not arise because of the operations of that period.

In a period of idleness or partial operation it would be necessary to cut down the depreciation provision proportionately.

REPORTS

Operating reports can be made daily, weekly and monthly, and reports on items of special interest whenever necessary. At the close of a cost period a set of permanent reports should be made up for presentation to the interested executives and officials and for the cost department files. These reports can be simple or elaborate according to requirements but inasmuch as they will be a permanent record and as such be referred to considerably in later periods, constituting a sort of cost history, it is probably advisable to go into detail to some extent.

A suitably ruled sheet can be provided for each department, process, or operation as the case may be. This can show all material charges, labor, fuel and burden expenses in separate sections. It can give the proportion of each unit of good product in comparison with a previous period, with an established standard cost, with a record minimum or with all of these. It can show total units charged, produced, scrapped, or lost with percentages showing efficiency for the period. Unit pieces and unit costs can be shown

and controllable or variable expenses can be separated from apportioned expenses.

COMPARISONS

The value of a good cost system increases with age. Not only because if properly operated, it becomes more and more accurate, or because executives gradually begin to place greater reliance on the figures presented, but because the element of comparison enters.

After a good system has been in operation for some years with reasonably full information on file it is possible when necessary or advisable to make comparisons over a period of years on nearly every element of cost and thus trace such element through periods of prosperity and depression.

Changes often destroy the basis of comparison and, therefore, if a reasonably good system is in use, changes should not be made without giving some thought to this particular angle.

DATE FOR COMPLETION OF COSTS

We often hear expressions such as these: "Costs are of no value unless completed by the 10th of the following month," or the date may be the 5th or 15th depending on what the speaker's experience has been. On this subject there is room for discussion. The final cost figures in a system such as outlined in this paper can be completed somewhere between the 10th and the 20th of the following month. Some cost accountants will maintain that this is too late.

I believe that ordinarily the 5th or the 10th are too late for figures which are needed immediately and that for figures which are not needed immediately correct figures by the 20th are better than estimated figures on the 10th. Under this system as outlined it is possible to make daily or weekly reports on subjects which need immediate attention and on urgent matters monthly reports can be made on the 2nd or 3rd of the following month, although it may not be possible to complete the monthly earnings' statement before the 18th to the 20th of the following month. Usually this date will serve as well as the 10th. In some cases closing by the 10th means estimated costs, that is, current month's production at the previous month's unit costs. This would necessitate compiling two costs for each period, first an estimated cost and second an actual cost, thereby making more work.

Under the system outlined estimates based on current month's production and previous month's unit costs can be made at any time. Estimates, in my opinion, should apply to the future and not to the past. This subject is treated more fully in a later paragraph.

STANDARD COSTS

Under conditions such as have existed for the past few years standard costs, to be a good guide, would have to be constantly changed and adjusted because of the violent fluctuations in labor and material costs.

A careful examination of past records would, however, permit of establishing standards not in value per unit of output, but in performance such as: a. Labor hours per unit, b. percentage of good product, c. percentage of scrap and furnace losses, d. unit output per furnace hour, e. total output per turn, week or month, and f. percentage of time equipment is in operation.

These standard performances applied to current labor rates and current material costs permit of standards based on monetary value being established as often as necessary and comparisons with actual performance can then be made.

ESTIMATED FUTURE COSTS

Regardless of the cost methods used or the date of closing, cost figures at best are historical in that they record past performances and results only. Under conditions existing for the last few years, with the rapid fluctuations in all labor and material costs, even the immediate past has not correctly reflected the future as far as costs are concerned. This is particularly true in industries such as the iron and steel industry where the rate of turnover is very low and some materials such as ore are carried in sufficient quantity for a full year's operation. What is needed by the management is present or future replacement costs and the farther into the future we can carry the forecast the better we will be liked.

The cost department which is most successful, most appreciated by the managers and owners, and which wields the greatest influence within its organization, is the department which is most successful in forecasting future or replacement costs.

After a cost system has been properly installed and is functioning, the completion of the monthly cost figures is largely a matter of routine.

The preparation of estimated cost figures one, two, three or even six months in advance is a subject requiring the most careful thought and attention but is the part of the work which, if carefully done, is the most valuable and may pay for the entire cost of the system many times over.

To forecast future costs, the cost accountant must have:

First, readily available summarized past records showing average, standard, maximum and minimum production, with labor hours, furnace hours, percentage of loss and any other necessary operating and statistical data necessary to tell him what the plants can do under prevailing conditions.

Second, he must follow the trend of business very closely and be able to utilize the very latest information on labor rates, freight rates, coal, coke and oil prices and any other commodity prices which will materially affect his costs. He must secure the latest available information from the purchasing, traffic and operating departments and he must be in close touch with the sales department and the management to know at what rate the plants will be operated.

After the cost department has succeeded in establishing a reputation for careful and reasonably accurate forecasts, executives and department heads will make increasing demands for special reports on many subjects some of which are: a. Fixing selling prices for the product, b. figuring a base for special quotations, c. effect of contemplated shutdown of plants or departments, d. stocks to be carried, e. calculations of savings on proposed improvements or new installations, and f. comparative costs of operation on different bases such as 8, 10 or 12 hour turns, etc.

The statement is often made that selling prices are not fixed by costs but by competition or by demand and supply. This is true to some extent. But in the long run I believe it cannot be successfully contradicted that costs regulate selling prices. At times selling prices may be determined by liquidation of stocks whose owners need cash; at other times by the supposed costs of manufacturers who are actually selling below cost; and at other times by demand which is in excess of supply. Even when these conditions exist the selling price has some relation to actual or supposed costs, that is, there is some cost basis used from which profits or losses are figured and this cost basis is a cost for, or of, that particular industry.

I believe that in the long run the most important basis for fixing selling prices is the cost basis of the leader in the industry. This leader is usually the largest producer and may be the largest producer because of lower costs, or a better knowledge of costs.

A thorough knowledge of costs is one of the elements which make leadership possible but even if leadership is not possible correct costs are essential to a thorough knowledge of results.

Vol. I

No. 7—Accounting for By-Products, *Research Dept. N. A. C. A.*

Vol. II

No. 7—Purchase Orders and Purchase Records, *Homer N. Sweet*

No. 9—Cost Accounting for Public Utilities, *E. D. Bistline*

No. 10—A Bibliography of Cost Books, *Research Dept. N. A. C. A.*

No. 15—What is Wrong with Cost Accounting? *G. Charter Harrison*

No. 16—A Method of Distributing Factory Payroll, *Matthew Porosky*

No. 17—Coal Production Costs, *R. W. Gardiner*

No. 18—Uniform Cost Accounting Methods in the Printing Industry, *W. B. Lawrence*

No. 19.—A Cost System for an Electric Cable Plant, *Fred F. Benke*

Vol. III

No. 3—Cost Accounting in the Laundry Industry, *Fred Elliott* (out of print)

No. 4—Some Cost Problems in the Hawaiian Sugar Industry, *F. A. Haenisch*

No. 5—Securing Effective Work from Labor, *J. L. McVicker* (out of print)

No. 6—Some Phases of Cost Accounting in the Chemical Industry, *C. B. E. Rosén*

No. 7—Cost Accounting in the Soap Industry, *William C. Koch*

No. 8—Relation to Budgetary Control to Cost Accounting, *J. O. McKinsey* (out of print)

No. 9—Methods of Accounting for Waste in a Cotton Spinning Mill, *George D. Klimmer*

No. 10.—List of References on Interest as an Element of Cost

No. 11—The Scrap Problem, *I. W. Kokins*

No. 12.—Logging Costs, *Horace J. Nelson* (out of print)

No. 13.—A Premium Incentive Wage Plan, *J. H. Paterson* (out of print)

No. 14.—Cost Methods in the Packing Industry, *J. H. Bliss* (out of print)

No. 15.—Flour Milling Costs, *C. A. H. Narlian*

No. 16.—Distribution of Operating Costs of Centralized Power Plants at Low Capacity, *Frank B. Wolfe*

No. 17.—Cost Accounting in the Canning Industry, *E. J. Coleman* (out of print)

No. 18.—Cost Accounting in the Oil Refining Industry, *U. Robert and J. J. Mulhern* (out of print)

No. 19.—Normal Burden Rates, *Charles Van Zandt*

No. 20.—Chocolate and Cocoa Costs, *George Rea* (out of print)

No. 21.—Salmon Canning Costs, *Rodney D. White* (out of print)

No. 22.—Principles and Practice of Construction Costkeeping, *William M. Affelder* (out of print)

Vol. IV

No. 1.—Cost Methods in a Hosiery Mill, *W. F. Evers* (out of print)

No. 2.—Woolen Mill Costs, *Clinton W. Bennett* (out of print)

No. 3.—First New England Regional Cost Conference.

No. 4.—Cost Accounting in the Manufacture of Iron and Steel Sheets, *Keith B. Woods*.

No. 5.—Steamship Operating and Terminal Costs, *Joseph J. Mulhern and Urbain Robert*.

No. 6.—Cost Practices and Problems in the Production of Coke, *C. C. Sheppard*.

No. 7.—Production Costs in the Manufacture of Phonograph Records, *C. J. Borton*.

No. 8.—Cost Problems in the Wrought Iron Industry, *Carl G. Jensen, Comp.*

Copies of the above Publications which are not out of print may be obtained from the office of the Secretary of the Association, 130 W. 42nd Street, New York City, at the price of 75 cents per copy.